11. BELMONT AWT EFFLUENT PUMP STATION

The 1994 Central Indianapolis Waterfront Concept Master Plan identified low flow conditions in Fall Creek as a challenge to achieving the beautification of the Central Indianapolis Waterfront. The 2001 Long Term Control Plan (LTCP) identified a Belmont water reclamation force main to convey treated effluent from the Belmont Advanced Wastewater Treatment (AWT) Plant as an option for flow augmentation in Fall Creek, Pleasant Run, and Pogues Run during the dry weather periods from late Spring to early Fall (i.e., May to October).

To provide reclaimed water to the Belmont Force Main, a new pump station is proposed at the Belmont AWT Plant. This station will pump treated effluent through the force main, discussed in Section 12 – Force Main Alternatives, to the outfall structures located on Fall Creek, Pleasant Run, and Pogues Run.

11.1 FLOW RATES

Originally, it was envisioned that 20 million gallons per day (mgd) of reclaimed water would be provided to Fall Creek, 5 mgd to Pogues Run and another 5 mgd to Pleasant Run. Subsequently, the City of Indianapolis Department of Public Works (DPW) requested an increase of 30 mgd, for a total of 60 mgd, to the proposed flow to provide reclaimed water to potential commercial and industrial users. Providing reclaimed water to potential users will require a pressurized system and possibly elevated tanks along the alignment. At this conceptual level, elevated tanks were not considered in the pump design. However, most of the head demand on the pumps is through dynamic losses. Minor revisions to the design will be required if elevated tanks are included to serve potential reclaimed water users. Prior to detailed design, a feasibility study should be performed to evaluate the practicality of reclaimed water use and potential users. Per the recommendations from that study, appropriate modifications to the pump station design should be completed.

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Typical users of reclaimed water include:

- Wetlands
- Parks
- Landscaping and golf courses
- Industrial processing
- Cooling towers
- Soil compaction and dust suppression at construction sites
- Recreational lakes, ponds and ornamental fountains
- Wetlands restoration
- Irrigate commercial nurseries,
- Flushing toilets and urinals
- Mixing concrete
- Flushing sanitary sewers

In other states, such as California, where reclaimed water use is practiced, there are extensive rules and regulations covering its usage. To distinguish reclaimed water from potable supplies and avoid potential cross-connections, proper signage, marking and color-coding of pipes, sprinkler heads, meter boxes and other irrigation equipment are required.

Certain reclaimed water applications require advanced treatment processes including, enhanced filtration, disinfection, reverse osmosis, etc. For example, most golf courses require lower Total Dissolved Solids (TDS) levels in reclaimed water than those found in treated wastewater effluent. This often necessitates additional treatment. It is strongly recommended that DPW interview their potential reclaimed water customers to identify accepted recycled water quality. It also is recommended that the Indiana Department of Environmental Management (IDEM) be contacted, as well as other permitting agencies, to discuss any potential distribution and use of reclaimed water requirements before proceeding with design.

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11.2 BELMONT AWT EFLUENT PUMP STATION

The Belmont AWT Effluent Pump Station will provide approximately 20 mgd of reclaimed water to Fall Creek, 5 mgd to Pogues Run and another 5 mgd to Pleasant Run. The DPW requested an additional 30 mgd to the proposed flow to provide reclaimed water to potential commercial and industrial users. Therefore, the total capacity of the Belmont AWT Effluent Pump Station will be 60 mgd.

Since the Belmont AWT Effluent Pump Station is not providing a drinking water supply or pumping wastewater, it is conceptually sized for a total installed capacity of 60 mgd. Therefore, a standby pump is not provided. The preliminary conceptual design is based on six 10 mgd pumping units. However, if a "firm" capacity of 60 mgd is desired, the Belmont AWT Effluent Pump Station can be designed based on six 12 mgd pumps, e.g., five pumps in service and one standby.

The preliminary design criteria for the Belmont AWT Effluent Pump Station are summarized in Table 11.1.

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Table 11.1 Belmont AWT Effluent Pump Station Preliminary Design Criteria	
Total Pump Station Capacity, mgd	60
Wetwell Design Criteria	
Trench width at bottom, ft.	4
Min water level above bottom, ft.	5.7
Main line influent pipeline size, in.	60
Branch influent pipeline size, in.	42
Pump Criteria	
Number of pumps	6
Type of pumps	Vertical Turbine
Rated flow, gpm (mgd)	8,330 (10)
Rated head, ft.	230
Estimated operating head range, ft.	170-250
Estimated motor size, hp	750
Drive type	4 Constant Speed 2 Variable Speed

The following sections elaborate on the above design criteria and discuss the various considerations in the conceptual design of the Belmont AWT Effluent Pump Station.

11.2.1 Site Selection Considerations

Based on discussions with DPW Engineering staff, two potential sites, Alternative 1 and Alternative 2, were identified for locating the Belmont AWT Effluent Pump Station. As shown on Figure 11.1, the proposed sites are located at the southeast corner of the Belmont AWT Plant, south of the filter building and north of the ash holding lagoon. Alternative 1 places the Belmont AWT Effluent Pump Station immediately east of the Filter Building. Alternative 2 places the Belmont AWT Effluent Pump Station immediately south of the Filter Building.

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Figure 11.1

11. BELMONT AWT EFFLUENT PUMP STATION

The two alternatives have been sited based on the following criteria:

- Avoiding sites earmarked for future Belmont AWT Plant expansion and development
- Locating the existing outfall pipeline in close proximity to the Belmont AWT Effluent Pump Station so that effluent can be diverted to the wetwell by gravity flow, as required
- Locating the Belmont AWT Effluent Pump Station such that it is hydraulically functional with the new outfall location (per DPW) as part of a future project

DPW has indicated that a future outfall location is currently in the planning phase. The work associated with the new outfall will be completed under a separate project. The Flow Augmentation System project should include piping or structures, as needed, to prepare for the connection and use of the new outfall location.

Alternative 1 has the potential for contaminated soils based on discussions with plant personnel. It is strongly recommended that environmental site assessments be conducted before finalizing the site selection.

Alternative 2 is located in close proximity to the filtration facility and an electrical ductbank. If Alternative 2 is selected, any expansion of the filtration facility will require close coordination. Also, the ductbank will either need to be relocated or the Belmont AWT Effluent Pump Station and piping needs to be sited such that the ductbank is not disturbed.

Enlarged site plans for Alternatives 1 and 2 are included as Figure 11.2 and 11.3, respectively.

11. BELMONT AWT EFFLUENT PUMP STATION

Figure 11.2

11. BELMONT AWT EFFLUENT PUMP STATION

Figure 11.3

11. BELMONT AWT EFFLUENT PUMP STATION

11.2.2 Pump Types

Vertical turbine pumps are proposed for the Belmont AWT Effluent Pump Station. Due to their efficiency, vertical turbine pumps will be the most economical from a long-term operation standpoint. Centrifugal end-suction, split-case or submersible pumps could be used, but are generally not as efficient as vertical turbine pumps. For the flow and heads required for this application, the vertical turbine pump would likely require multiple stages. Multiple-stage vertical turbine pumps are built to tighter clearances, which increases their efficiency. An advantage of the multiple-stage vertical turbine pump is a steeper pump curve. This is useful when the pumps are driven by a variable speed drive. The steep curves allow for finer flow control based on speed modulation. Generally, the steeper curve also will result in greater turndown capability.

An advantage of submersible pumps is that a superstructure is not required, which would reduce capital costs. However, submersible pumps cannot be exercised manually and are more difficult to troubleshoot. Pump exercising will be required since the Belmont AWT Effluent Pump Station is expected to sit idle for eight to nine months of the year when there will be no reclaimed water demands. Vertical turbine pumps can be exercised manually by rotating the exposed pump and motor shaft. The pump speed can be determined easily by using a laser tachometer or stroboscope on the exposed rotating shaft. This information can be very useful when maintaining and adjusting the variable speed drive or troubleshooting pump performance.

Reclaimed water is considered to be treated effluent and will contain minimal solid material. The large passages provided by a submersible pump are not required. Therefore, vertical turbine pumps are preferred for the Belmont AWT Effluent Pump Station.

Table 11.2 summarizes vertical pump design and operation considerations.

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Table 11.2
Belmont AWT Effluent Pump Station Pump Design/Operation Considerations

Design/Operation Considerations	Vertical Turbine Pump
Capital Cost	Varies but typically slightly more than horizontal split case
Maintenance Cost	Shorter life than the horizontal-split case, repair costs can be excessive as there are a lot of wearing surfaces
Pump Station Footprint Requirements	Requires smaller footprint since the motor and discharge head are situated vertically on the operating floor
Pump Station Height Requirements	Vertical equipment arrangement requires a tall structure
Submergence Requirements	Pump bowls can be set as low as necessary to achieve adequate NPSH without impacting the operating floor elevation
Turndown Capabilities	40% to 50% of rated capacity
Maintenance Accessibility	Requires pump assembly to be lifted by overhead bridge crane or with a mobile crane through a removable roof hatch or skylight
Efficiency	Varies; typically can achieve a high efficiency (80% +)

11.2.3 Pump Station Layout

The ultimate capacity of the Belmont AWT Effluent Pump Station is 60 mgd. The preliminary design is based on 10 mgd pumping units. The Belmont AWT Effluent Pump Station can be upgraded in increments of 10 mgd by adding pumping units as desired by DPW based on the reclaimed water demand. Once the actual reclaimed water demand is quantified, the Belmont AWT Effluent Pump Station design should be evaluated to determine the proper capacity, pumps and piping for the Flow Augmentation System.

The preliminary design of the Belmont AWT Effluent Pump Station will consist of six vertical turbine pumps (60 mgd installed capacity) within a structure sized approximately 40 feet by 80 feet in plan dimensions. The pumps should be oriented in a “trench” style wetwell. In this arrangement, the pump impellers are located in a

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narrow trench that limits the excavation and dewatering requirements, thereby reducing the footprint. With this geometry, the water enters from the end of the wetwell and in line with the pumping units. Figure 11.4, taken from the Hydraulic Institute standard for intake design, illustrates this arrangement.

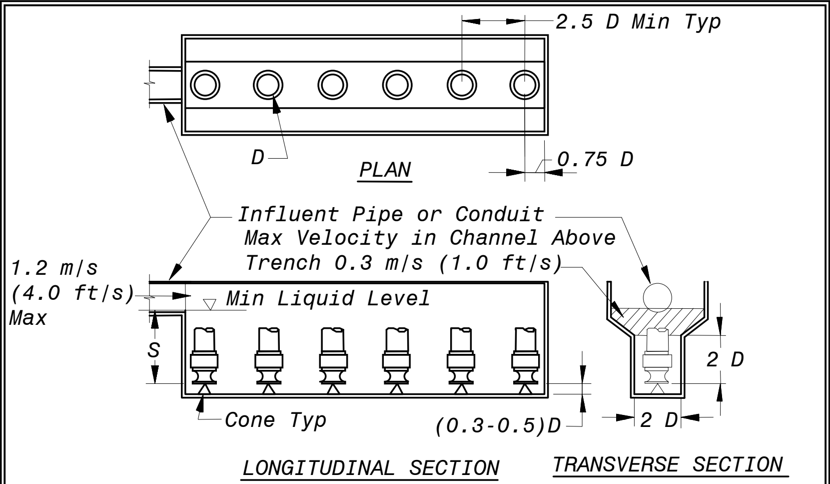

Figure 11.4 Trench Style Pump Station

The proposed layout for the Belmont AWT Effluent Pump Station would be similar except that the wetwell will be divided into two equal halves. A sluice gate will divide the wetwells with three pumps on either side. Basically, the two sides of the wetwell will be symmetrical, each with its own influent pipe and three pumps. This configuration will allow the dimensions of the upper portions of the wetwell to be slightly smaller due to reduced cross flows. The configuration also will provide a level of redundancy for wetwell maintenance and cleaning.

A magnetic flowmeter is proposed to measure the Belmont AWT Effluent Pump Station discharge. Magnetic flowmeters are accurate and have a large usable range from 10 to 100 percent of flow. They do not have any obstructions and result in very low head losses. The flowmeter should be installed on the effluent pipeline

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downstream of the pump discharge. Due to its laying length and installation requirements (five diameters of straight pipe upstream of the meter and two diameters downstream), the flowmeter should be located within a valve vault outside the Belmont AWT Effluent Pump Station as shown on Figures 11.2 and 11.3. The flowmeter transmitter display will be indicated on the control panel within the Belmont AWT Effluent Pump Station and can be connected to the remote SCADA system. The proposed plan and section for the Belmont AWT Effluent Pump Station are shown on Figures 11.5 and 11.6, respectively.

11.2.4 Pump Station Structure

Conceptually, the Belmont AWT Effluent Pump Station has been planned as a single-story brick and block building approximately 40 feet by 80 feet in plan dimensions, with an approximate wall height of 25 feet and a roof, as shown on Figures 11.5 and 11.6. The pump motors, associated electrical equipment and discharge piping will be housed in the building constructed above the wetwell. The pump discharge should be located above the operating floor to allow easy access to the discharge piping and valves for maintenance. The architecture can be designed to match the existing structures at the Belmont AWT Plant or as desired by DPW.

The Belmont AWT Effluent Pump Station wetwell should be a cast-in-place concrete structure. The actual depth will be verified during the detailed design based on the intake hydraulics, effluent flow elevations and the selected site. Since the wetwell will be divided equally, half of the wetwell can be taken out of service for maintenance.

The Belmont AWT Effluent Pump Station should be designed with a bridge crane for equipment removal. Interior overhead clearance in the pump room will be approximately 25 feet to facilitate equipment removal through an exterior rolling door. The pump station ground floor elevation should be above the 100-year flood plain elevation to limit the possibility of flooding.

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Figure 11.5

11. BELMONT AWT EFFLUENT PUMP STATION

Figure 11.6

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11.2.5 Piping

A flow diversion structure will be constructed on the existing outfall piping, immediately downstream of the ozonation facility, to direct flow to the Belmont AWT Effluent Pump Station. New piping will route the reclaimed water from the flow diversion structure into flow control chambers associated with either Alternatives 1 or 2, shown on Figure 11.1, prior to the wetwell. The Belmont AWT Effluent Pump Station discharge will be conveyed through the Belmont Force Main to Fall Creek, Pogues Run and Pleasant Run for the flow augmentation.

The effluent pipeline design and diameter selection will impact the required pumping energy. The capital cost to increase the pipeline diameter can reduce pumping energy costs for the lifetime of the Belmont AWT Effluent Pump Station. For that reason, it is assumed that the pipeline will be designed for a maximum velocity not to exceed 6 feet per second (fps) at the maximum design flow. Larger pipeline diameters will increase the energy savings that could be realized. However, the energy savings would need to be offset by the increased construction cost for a larger pipeline.

A transient or surge analysis should be conducted during the detailed design of the Belmont AWT Effluent Pump Station. Unless surge protection measures are implemented, the life expectancy of the installation may be reduced or sudden failure may result. High pressures may weaken and burst pipe sections. In addition, a pressure surge will increase the loads on pipe supports, especially at bends. A transient analysis will identify whether surge protection is required and the most practical form, e.g., provision of surge vessels or tanks, installation of surge protection valves, air valves, etc. For this conceptual design, the pumps will be provided with discharge check and isolation valves. The check valves will protect the pumps from reverse flow in the event of a single pump failure while other pumps are operating. The check valve also would limit reverse flow in the event of a power failure. The isolation valves will allow the maintenance staff to isolate and remove one pump without taking down the entire pump station. The

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check valve should be a swing check valve or pneumatically operated control valve depending on the results of the transient analysis. The isolation valve should be an American Water Works Association (AWWA) style butterfly valve.

11.2.6 Controls Considerations

The Belmont AWT Effluent Pump Station should provide treated effluent to augment flows in Fall Creek, Pogues Run and Pleasant Run. As a result, it will not be in continuous operation. To optimize the required flow, variable frequency drives (VFD) are proposed for two of the pumps. The VFD-operated pumps will give operators the capability of adjusting flows through the pumps to meet the variable flow augmentation conditions in Fall Creek, Pogues Run and Pleasant Run. For example, if 25 mgd of flow augmentation is required, two constant speed pumps and one VFD pump operating at 50 percent turndown will meet the 25 mgd flow demand.

The Belmont AWT Effluent Pump Station should be tied in to the SCADA system at the Belmont AWT Plant to automate and control the pump flows. This also will enable diversion of the required amount of Belmont AWT Plant effluent into the Pump Station and Belmont Force Main. A Preliminary Process and Instrumentation Diagram (P&ID) for the Belmont AWT Effluent Pump Station is shown in Figure 11.7.

During inactive periods, it is recommended that the pumps be rotated monthly to keep the bearings from seizing or developing flat spots. A bearing supporting the idle shaft, pump or other equipment can develop a flat spot on its rotating element. For a thrust bearing, the flat spot would develop on the rotating pins within the bearing. For a ball bearing, the flat spot would develop on one of the balls carrying the majority of the weight at the position where the pump stopped. By manually rotating the pump a couple of revolutions, the load is shifted off of the wear point to another point, thus preventing damage to the bearing.

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INSERT FIGURE 11.7